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| Centre Number       |  |  |  |  |  | Candidate Number |  |  |  |  |
| Surname             |  |  |  |  |  |                  |  |  |  |  |
| Other Names         |  |  |  |  |  |                  |  |  |  |  |
| Candidate Signature |  |  |  |  |  |                  |  |  |  |  |



General Certificate of Education  
Advanced Subsidiary Examination  
January 2013

# Human Biology

## HBIO2

**Unit 2 Humans – their origins and adaptations**

**Tuesday 15 January 2013 1.30 pm to 3.00 pm**

**For this paper you must have:**

- a ruler with millimetre measurements
- a calculator.

**Time allowed**

- 1 hour 30 minutes

**Instructions**

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

**Information**

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You are expected to use a calculator where appropriate.
- You will be marked on your ability to:
  - use good English
  - organise information clearly
  - use scientific terminology accurately.

| For Examiner's Use  |      |
|---------------------|------|
| Examiner's Initials |      |
| Question            | Mark |
| 1                   |      |
| 2                   |      |
| 3                   |      |
| 4                   |      |
| 5                   |      |
| 6                   |      |
| 7                   |      |
| 8                   |      |
| 9                   |      |
| 10                  |      |
| TOTAL               |      |



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WMP/Jan13/HBIO2

## HBIO2

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ANSWER IN THE SPACES PROVIDED**



Answer **all** questions in the spaces provided.

**1** Humans have evolved adaptations that increase survival.

**1 (a)** Humans have adaptations involving behaviour. Three of these adaptations are:

- **A**, communication using facial expressions
- **B**, development of language during childhood
- **C**, extended childhood.

Complete the table to show which adaptation **A**, **B** or **C** contributes to the advantages shown. The first one has been completed for you.

| Advantage                                                 | Adaptation |
|-----------------------------------------------------------|------------|
| Complex ideas can be described, explained and understood  | <b>B</b>   |
| Smiling at a stranger means you are not a threat          |            |
| Signals can be understood even if languages spoken differ |            |
| Reproduction normally occurs when socially mature         |            |
| Allows time for learning of complex tool use              |            |

(3 marks)

**1 (b) (i)** Give **two** advantages of bipedalism.

1 .....

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2 .....

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(2 marks)

**1 (b) (ii)** Give **one** advantage of having opposable thumbs.

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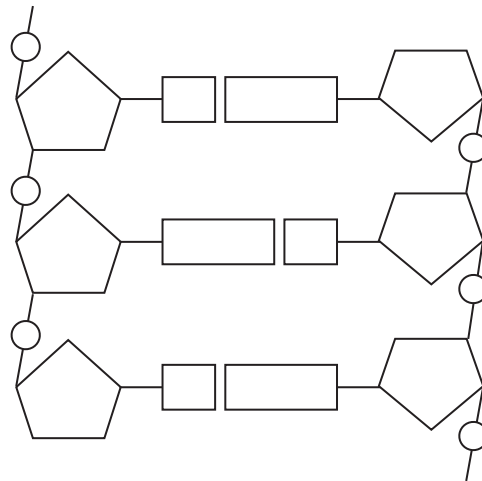
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(1 mark)

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- 2 The diagram shows part of a DNA molecule.



- 2 (a) Add the following to the diagram.

- 2 (a) (i) Label **one** deoxyribose with a letter **D**.

(1 mark)

- 2 (a) (ii) Label **one** base with a letter **E**.

(1 mark)

- 2 (a) (iii) Draw a box around **one** nucleotide.

(1 mark)

- 2 (b) What holds the two DNA strands together?

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(1 mark)

- 2 (c) When nucleotides are joined together in DNA synthesis, a molecule of water is released. Name the type of reaction that joins the nucleotides together.

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(1 mark)

- 2 (d) A gene is a section of the DNA molecule. It contains a sequence of bases. What do these bases code for?

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(1 mark)



**3** The fossil record can provide evidence for the process of evolution. A complete fossil record exists for some species but not others.

**3 (a)** What is a fossil?

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(1 mark)

**3 (b)** Suggest why the fossil record is incomplete for some species.

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(1 mark)

**3 (c)** Give **two** ways in which fossil evidence can be dated.

1 .....

2 .....

(2 marks)

4

**Turn over for the next question**

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**4 (a)** Cattle are thought to have been one of the first animals domesticated by humans, around 8500 years ago.

**4 (a) (i)** Suggest **one** piece of archaeological evidence that early humans domesticated cattle.

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(1 mark)

**4 (a) (ii)** The domestication of cattle would have resulted in surpluses of food. Suggest **two** ways this may have affected human societies.

1 .....

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2 .....

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(2 marks)

**4 (a) (iii)** The domestication of cattle can reduce biodiversity. Suggest how.

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(1 mark)



- 4 (b)** European farmers have been selectively breeding cattle for centuries. In Belgium, farmers have selectively bred a breed called the Belgian blue. These cattle have very large muscles.

Describe how selective breeding could have been used to produce cattle with large muscles.

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(2 marks)

- 4 (c)** The Belgian blue is bred for meat.

Other than providing meat, suggest **two** characteristics of other cattle which made humans want to domesticate them.

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(2 marks)

8

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- 5 (a)** Explain how meiosis leads to the chromosome number being kept constant from one generation to the next in humans.

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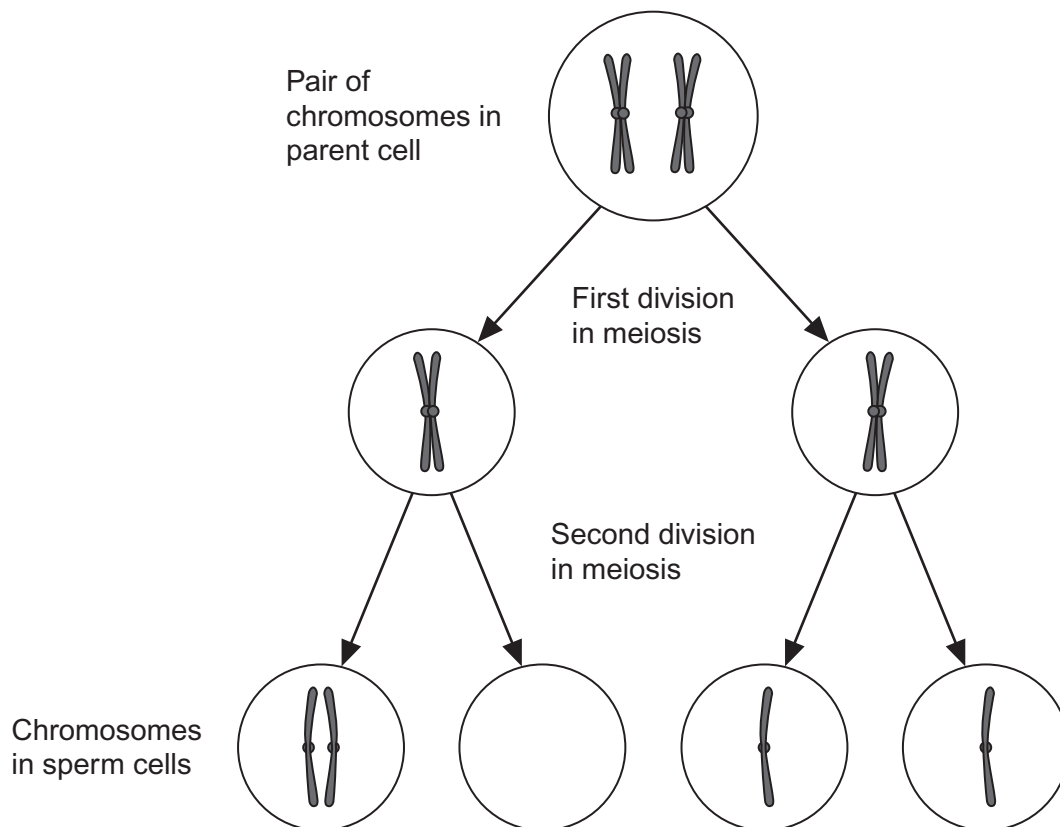
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(2 marks)

- 5 (b)** There are some conditions in humans where a person has an extra chromosome.

The diagram below shows an error affecting one pair of chromosomes during meiosis in sperm production. After fertilisation, this error could lead to the development of a child with an extra chromosome.



- 5 (b) (i)** Put an **X** on the diagram where the error in meiosis occurs.

(1 mark)

- 5 (b) (ii)** Draw a box around **one** of the sperm cells in the diagram which would lead to the development of a child with an extra chromosome.

(1 mark)



**5 (b) (iii)** The chromosomes in the parent cell are homologous.

Explain what this means.

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(2 marks)

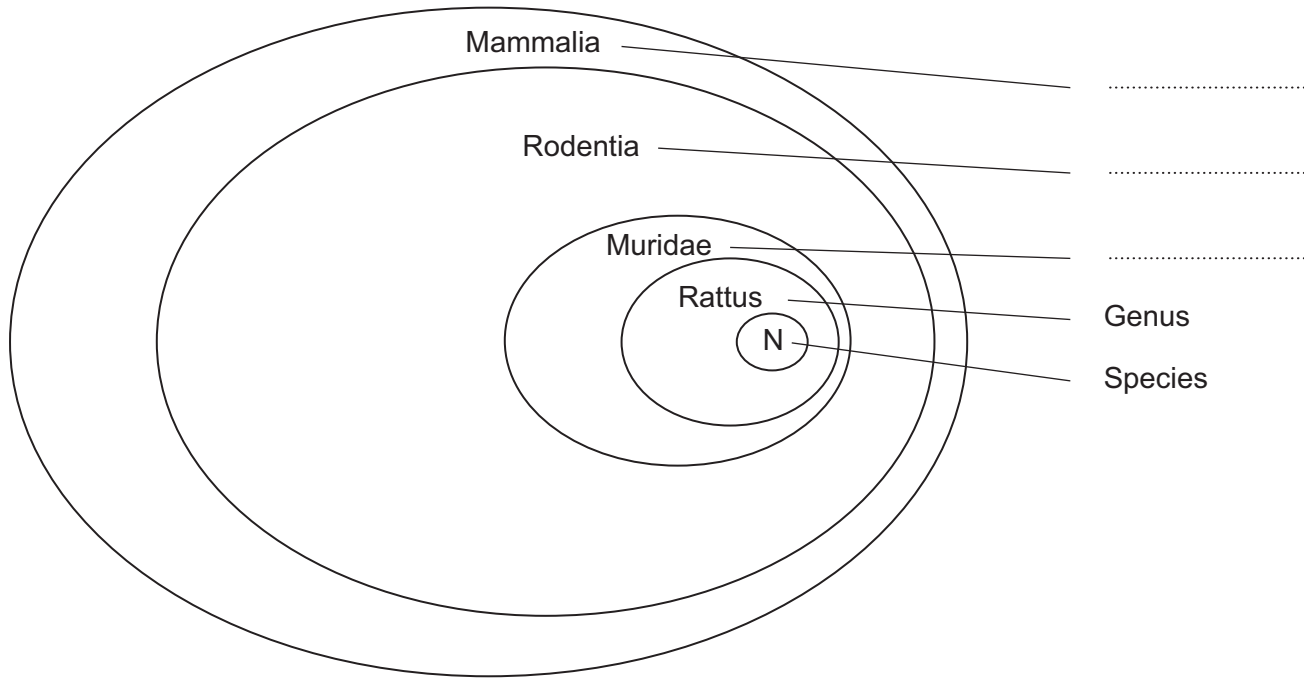
6

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- 6 (a)** The common brown rat, *Rattus norvegicus*, is a mammal in the animal kingdom. The diagram shows the taxonomic group to which the rat (labelled **N**) belongs.



- 6 (a) (i)** Label the diagram to show the names of the missing taxonomic groups. (2 marks)

- 6 (a) (ii)** The grey squirrel, *Sciurus carolinensis*, belongs to another taxonomic group called Sciuridae in the group Rodentia.

Complete the diagram by adding circles to show this information and label the squirrel species with a **C**.

(1 mark)

- 6 (b)** What is meant by a hierarchical classification system?

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(2 marks)



**6 (c)** Originally classification systems placed organisms into groups based on features people could easily see. A wider range of evidence is now used to clarify phylogenetic relationships between them.

**6 (c) (i)** What is meant by a phylogenetic relationship?

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(1 mark)

**6 (c) (ii)** Explain **one** biochemical method that can be used to identify phylogenetic relationships between organisms.

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(2 marks)

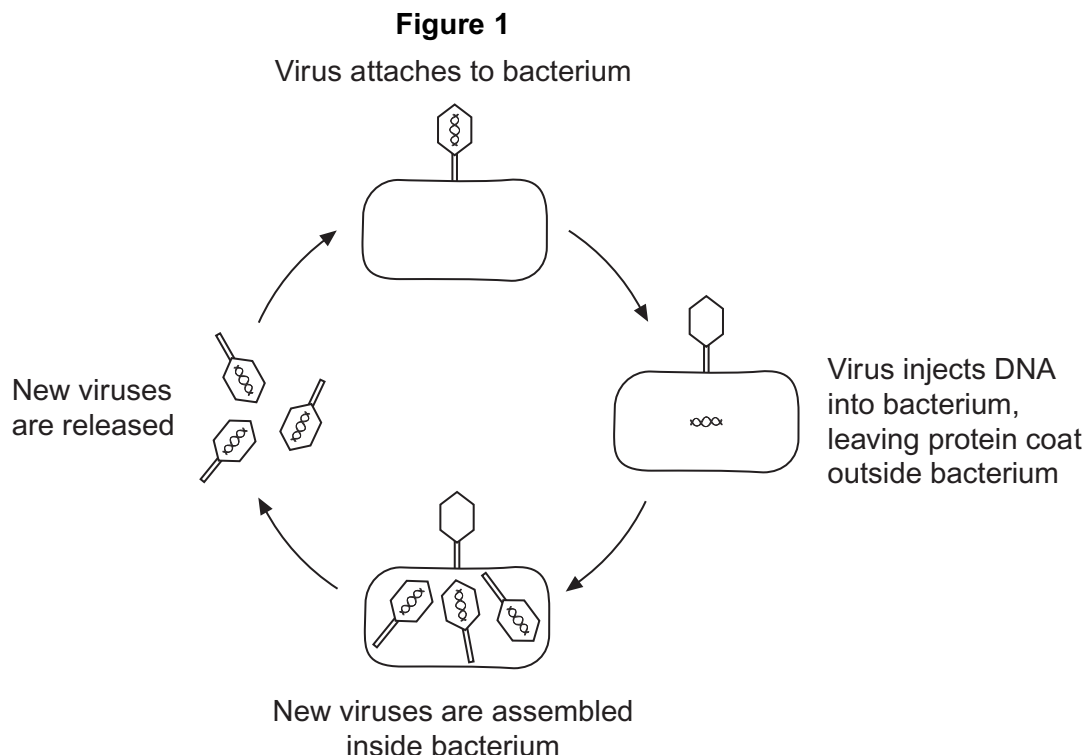
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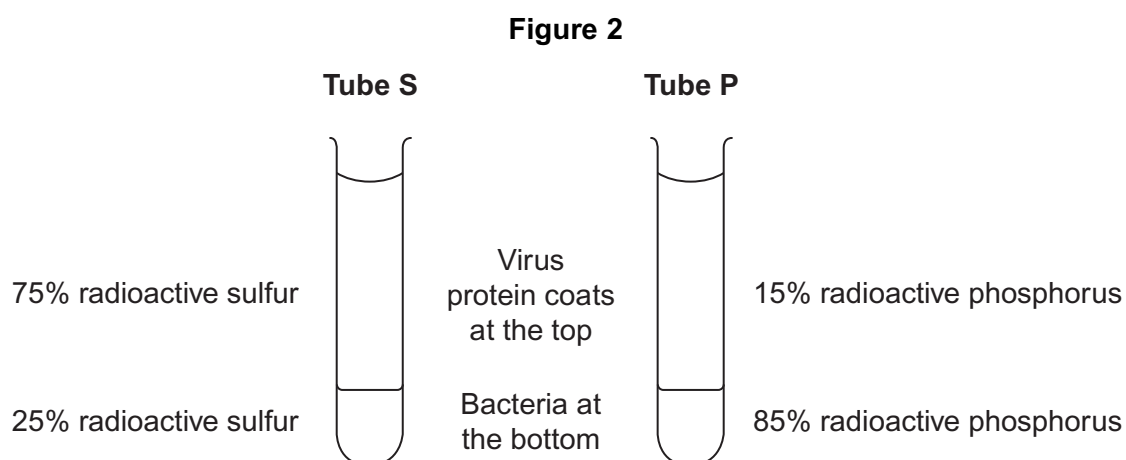
- 7 Scientists performed experiments with viruses that infect bacteria to try and determine what the genetic material is. The viruses consist of DNA surrounded by a protein coat. **Figure 1** shows how a virus infects a bacterium.



The scientists carried out the experiment in the following way.

- They labelled the protein coat of viruses with **radioactive sulfur** and added them to bacteria in tube **S**.
- They left viruses and bacteria for several hours so viruses could infect the bacteria.
- They then separated the virus protein coat from the bacteria.
- Layers formed in the tube. The scientists checked each layer for radioactivity.
- They repeated the experiment and labelled the DNA of viruses with **radioactive phosphorus** and added them to fresh bacteria in tube **P**.

**Figure 2** shows the results of the experiment.



**7 (a)** Use all the information to suggest why radioactivity is found in **both** layers in:

**7 (a) (i)** Tube **S**

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(2 marks)

**7 (a) (ii)** Tube **P**.

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(2 marks)

**7 (b)** Do the results shown in **Figure 2** provide evidence that DNA is the genetic material?  
Explain your answer.

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(2 marks)

**7 (c)** The scientists repeated the experiments several times.  
Suggest how this might have improved their results.

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(1 mark)

7

Turn over ►

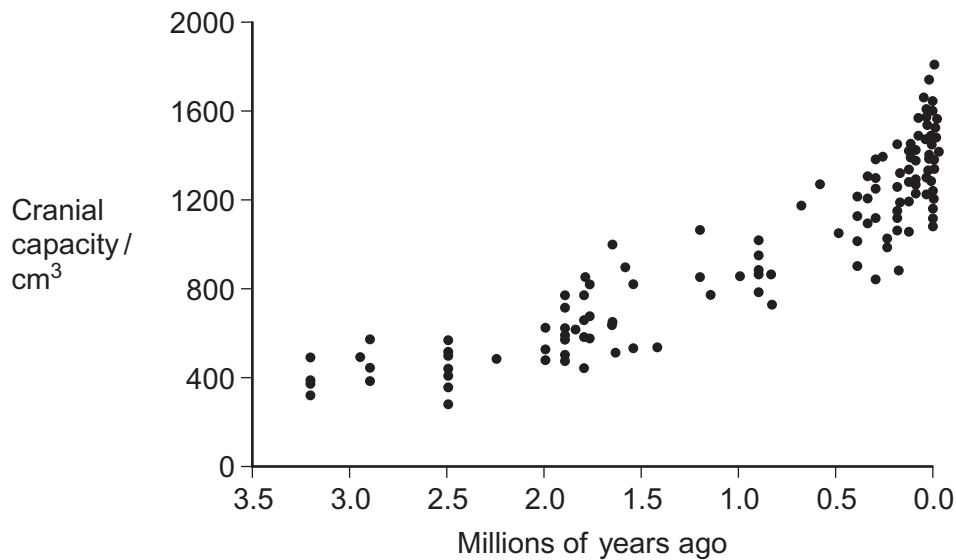


- 8 (a)** Complete the table below showing the hominid chronology.

| Time / million years ago | Hominids alive          |
|--------------------------|-------------------------|
| 5.0 – 2.2                | <i>Australopithecus</i> |
| 2.3 – 1.7                | <i>Homo habilis</i>     |
| 1.7 – 0.5                | <i>Homo erectus</i>     |
| 0.4 – 0.03               |                         |
| 0.15 to present          |                         |

(2 marks)

- 8 (b)** The graph below shows how adult cranial capacity has changed in hominids over the last 3.5 million years.



- 8 (b) (i)** A student concluded that as hominids evolved over the last 3.5 million years their brains increased in size.

Does the evidence in the graph support this conclusion? Give reasons for your answer.

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(2 marks)



- 8 (b) (ii)** From studying hominid skulls and other bones the student also concluded that hominids had an upright posture.

Explain how the study of hominid skulls and other body parts provides evidence of an upright posture.

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(3 marks)

(Extra space) .....

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**Turn over for the next question**

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- 9 (a)** During the development of cancer some of the cancer cells may break away from the original tumour and invade other organs.

Name this process.

.....  
(1 mark)

- 9 (b)** Scientists investigated the effect of air pollutants on the risk of developing lung cancer. They investigated the health records of men between the ages 40–75 years who lived in one city between 1950–1990.

The table shows their results as they presented them.

| Type of air pollutant | Level of exposure | Sample size | Cases of lung cancer per 1000 people |
|-----------------------|-------------------|-------------|--------------------------------------|
| Diesel exhaust fumes  | Low               | 3232        | 30                                   |
|                       | High              | 174         | 41                                   |
| Petrol exhaust fumes  | Low               | 3237        | 30                                   |
|                       | High              | 169         | 43                                   |
| Asbestos fibres       | Low               | 3098        | 29                                   |
|                       | High              | 308         | 43                                   |
| Radon gas             | Low               | 850         | 32                                   |
|                       | High              | 852         | 33                                   |

- 9 (b) (i)** Cases of lung cancer are given as cases per 1000 people.

Explain why.

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 (2 marks)



- 9 (b) (ii)** Use the table to calculate the actual number of cases of lung cancer in the sample exposed to a low level of radon gas. Show your working.

Answer .....  
(2 marks)

- 9 (c)** Does the evidence from the table prove that exposure to air pollutants causes lung cancer? Explain your answer.

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(Extra space) ..... (3 marks)

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**Turn over for the next question**

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**10** Read the following passage.

There is a British mountaineer who has successfully climbed Mount Everest several times.

Before attempting this climb, he gains weight to build up his energy reserves. Once ready he spends about 50 days on the mountain, of which only 21 days are spent climbing. He climbs the mountain in stages, with rests for several days at each height. The rests allow his body to adapt to lower and lower concentrations of oxygen in the air as height increases. One way in which his body adapts is by increasing cardiac output. **5**

On the day he attempts to reach the summit, he climbs above 8000 m. Here there is so little oxygen in the air that his body depends mainly on anaerobic respiration. His walking speed becomes slower and slower, he feels more and more tired and his heart rate increases. **10**

On Everest, the air temperatures can be very low and the intensity of the sunlight can be very high. The mountaineer wears special equipment to protect him from these harmful factors. The local Sherpa people who live near Everest have anatomical adaptations to the low oxygen content of the air, the low temperatures and the very intense sunlight. **15**

Use information from the passage and your own knowledge to answer the questions.

- 10 (a) (i)** One way in which the mountaineer's body adapts to low oxygen concentrations is to increase cardiac output (lines 7 and 8). How is cardiac output calculated?

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(1 mark)

- 10 (a) (ii)** Suggest and explain **one** other way in which the mountaineer's body may adapt to the lower oxygen concentrations.

Suggestion .....

Explanation .....

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(2 marks)



Describe how this increase is controlled.

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**Turn over ►**



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**10 (d)** The local Sherpa people who live near Everest have adaptations to the low oxygen content of the air, the low temperatures and the very intense sunlight (lines 15 to 17).

**10 (d) (i)** Give **one** anatomical adaptation the Sherpa people may have that allows them to cope with the low temperatures. Explain how this adaptation helps them to survive low temperatures.

Adaptation .....

Explanation .....

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(2 marks)

**10 (d) (ii)** Give **one** anatomical adaptation that may protect the skin of the Sherpas from very intense sunlight.

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(1 mark)

**10 (d) (iii)** Explain **one** health problem the Sherpa people may experience if they were to move to an area where the intensity of the sun is much lower.

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(2 marks)

20

**END OF QUESTIONS**



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